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Mealybugs and pasture dieback

Mealybugs (soft-bodied scale insects) are sucking pests that attack pastures, cereal crops and turf grass in Australia and around the world. They are typically covered in a soft, waxy coat that gives them a white, 'mealy' appearance. This technical note describes common pasture mealybug species and impacts, and provides information to help landholders identify and mitigate against mealybug infestations.

Pasture mealybugs

Many species of mealybug attack grasses and grass crops. Sugarcane mealybug, *Saccharicoccus sacchari*, is frequently found on sugarcane in Queensland. Ryegrass mealybug, *Phenacoccus graminicola*, attacks pasture in South Australia, and Rice or Tuttle mealybug, *Brevennia rehi*, is found on rice in Australia and is an international pest of turf grasses. In New Zealand, *Balanococcus poae* can cause severe pasture dieback in temperate ryegrass (Pennell et al 2005).

Rhodes grass mealybug, *Antonina graminis*, attacks many species of tropical grasses. Though of Asian origin, it is common on Rhodes grass in Queensland (Fig. 1). It is typically found under the leaf sheath around nodes, and has a hard scale covering and a distinctive waxy filament or 'tail' (Dale 2017).

The paspalum mealybug, *Heliococcus summervillei* (Brookes 1978) was first observed causing severe dieback in paspalum in Queensland in 1926 (Summerville 1928). It caused yellowing and then purple streaking of the leaves, with the purple sometimes extending to the whole leaf, and death of the plant. Mealybug outbreaks were greatest in thick, matted grasses. It was successfully raised on Rhodes grass and kikuyu.

H. summervillei was observed again causing dieback on paspalum in Atherton in 1938. In 1998, it caused severe pasture dieback in New Caledonia, but by 2000 had ceased to be a problem, which was presumed to be due to a rise in the number of

Figure 1: Rhodes grass mealybug, *Antonina graminis*.
Photo: A. Dickson (QUT)

natural enemies (Mille et al 2016). *H. summervillei* has also been described from sugar cane in Pakistan and in West Bengal (India) on rice.

Mealybugs and pasture dieback

Pasture dieback has caused significant losses to pastures across Queensland (Buck 2017). Early symptoms include a purple or mauve streak along the leaf blades (Fig. 2). Later symptoms include extensive root rot, leaf yellowing and purple/brown streaking (Fig. 2), and loss of plant structure. Dead plants disintegrate easily when pressure is applied.

Pasture dieback has been reported in Queensland for more than 25 years, but appears to have spread significantly in recent years after major weather events. It is sometimes observed initially in small patches of approximately 5m^2 and then spreads slowly across the pasture, but can spread rapidly, affecting large areas in a few months (Fig. 3). It also spreads along roadsides, rivers and creeks.

The association of mealybugs with pasture dieback has been reported by growers, though is not always observed. Inspections funded by MLA found mealybugs in 100 per cent of 12 active dieback sites in Baralaba, Banana, Rockhampton, Gayndah, Maryborough, Kin Kin, Cooroy and Brisbane between July and October 2018 on multiple grasses (Rhodes, buffel, creeping bluegrass, paspalum and rye grass that had been planted as a forage crop).

Mealybugs were found on both roots and leaves. Early instar mealybugs were found several metres from the area of dieback, before symptoms develop. The abundance of mealybugs and symptoms of dieback (purple colour, root dieback) increased closer to the dieback area.

Mealybug and dieback symptoms are also associated with root death in the field, in which only the central cortex of the root remains (Fig. 4). This suggests that pasture mealybug infestation precede dieback, that an increase in mealybugs is associated with an increase in root dieback and dieback symptoms, and that roots as well as leaves must be inspected for mealybugs.

Adult mealybugs from all sites were identified by Biosecurity Queensland as *Heliococcus* near *summervillei*. This is either a close relative of *H. summervillei*, or the same species with minor differences resulting from environmental factors. Work on identification is ongoing.

Morphology can only be used to identify adult mealybugs. DNA sequence markers have been developed to identify early instars and 'crawlers', and to facilitate identification of field samples. DNA amplification and sequencing at QUT of three different marker regions (Dynamin, 28s and 18s) in pasture mealybug showed a high degree of sequence similarity across all sites. Comparison with sequences on international databases confirmed similarity with other species of *Heliococcus*. Fresh samples of the New Caledonian pasture mealybug are being sought by entomologists at the Institut Agronomique néo-Calédonien for comparison with Queensland specimens.

Mealybugs collected from sugarcane adjacent to pasture dieback were confirmed to be sugarcane

Figure 2: Early symptoms of pasture dieback: purple streaks on paspalum. Photo: R. Morgan, C. Hauxwell (QUT)

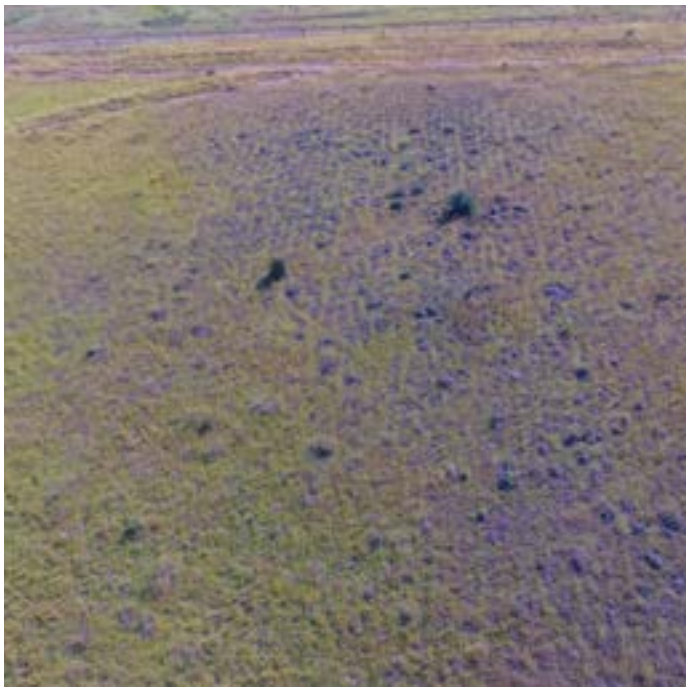

Figure 3: Pasture dieback. Photo: John Middlemount

mealybug, S*. sacchari*. No cross-over between pasture mealybug and sugarcane has been found to date.

Experiments have not yet confirmed that mealybugs cause dieback, but accidental introductions of mealybug into potted grasses were found to be *Heliococcus* nr *summervillei*, and were associated with symptoms of dieback in combination with inoculation of plant pathogens.

Pasture mealybug biology

H. nr *summervillei* can be found as adults, reproductive masses and early instars on both roots and leaves on a range of grass species. It attacks paspalum, buffel grass and creeping bluegrass, and may move on to other species including Rhodes grass and rye grass. Forage legumes (including clover and leucaena) and other dicots appear to be unaffected.

Mealybugs feed with piercing mouthparts that they

Figure 4: Overwinter early instar 'crawlers' associated with roots in soil showing the exposed root cortex.
Photo: C. Hauxwell (QUT), 2018

Figure 6: Pasture dieback mealybug reproductive mass and early instar crawlers in soil at a depth of 800mm.
Photo: C. Hauxwell (QUT), 2018

Figure 5: Mealybug reproductive mass at 300mm depth in soil.
Photo: C. Hauxwell (QUT), 2018

Figure 7: Pasture mealybugs have been found at up to 800mm in the soil. Photo: R. Morgan, C.Hauxwell (QUT), 2018

insert into the plant. They inject saliva containing microorganisms that may suppress the plant immune system and increase infection by plant pathogens. Mealybugs feeding on roots may cause necrotic lesions and constriction of phloem in roots, allowing plant pathogens to infect the plants.

Like other mealybugs, pasture mealybug can reproduce parthenogenetically, i.e. by females alone. In the winter of 2018, early instar pasture mealybug

Figure 8: Spring rain and warmth bring adult females (arrow) to the soil surface, sometimes in large numbers.
Photo: R. Morgan, C. Hauxwell (QUT) 2018

Figure 9: Early instar mealybugs (upper arrow) associated with purple streaking that is an early symptom of pasture dieback (lower arrow). Photo: R. Morgan, C. Hauxwell (QUT) 2018

Figure 10: Early instar pasture mealybug nymphs.
Photo: A. Dickson (QUT) 2018

Figure 11: Adult female pasture mealybug, H. nr. summervillei.
Photo: A. Dickson (QUT) 2018

'crawlers' and reproductive masses were found at low densities in soil associated with roots of plants affected by dieback (Figs. 4, 5). Intermediate instar mealybugs and reproductive masses were also found on leaves.

Pasture mealybug can overwinter and survive dry conditions and severe pasture dieback on roots and deep in the soil profile. Dry conditions favour survival in the soil, and prolonged flooding may kill mealybugs. Mealybugs and reproductive masses have been found overwintering in soil at depths of up to 800mm in pasture severely affected by dieback (Fig. 7). This suggests that mealybugs persist in the soil through cold and dry conditions, and may persist to emerge in spring to re-infest pastures. Sugarcane mealybug and *Solenopsis* mealybug (in cotton) also persist on underground parts of the plant and emerge in spring (DAFF Qld 2013, SRA 2013).

Warm spring conditions and rain may bring mealybug populations to the surface to breed and dis-

perse. In October 2018, large numbers of mealybug adults and nymphs were observed in leaf litter and on leaves of paspalum showing early symptoms of dieback (Figs. 8, 9). A small number of winged males were also found.

Early instar nymphs or 'crawlers' are very small - approximately 200 to 400 µm (under half a millimetre) and difficult to identify with the naked eye (Fig. 10). Adult females are larger, up to 2 or 3mm long, and may be pink or white (Figs. 8, 11).

The development time for pasture mealybug is not yet known but earlier records suggest about 70 days (Summerville 1928). In comparison, sugarcane mealybugs have a development time of four weeks.

Early instar mealybug 'crawlers' can move short distances on the plant and soil or may be blown on prevailing wind, which could give rise to the creeping spread of pasture dieback. They can also be dispersed over longer distances by wind and storms, on vehicles, clothing and livestock. The waxy filaments allow them to float and be dispersed by water. They may also be carried into the soil by ants.

Generalist predators such as ladybeetles and lacewings are likely to eat the mealybugs. The ladybeetle *Cryptolaemus* was found predating the mealybug (Summerville 1928). A Chalcid wasp, *Callipteroma sexguttata*, was found to parasitise *H. summervillei* "in fairly large numbers". Research on other natural enemies and potential biological controls is ongoing.

Good practice for mealybug mitigation

- Regularly monitor pastures and livestock
- Report any suspicious symptoms
- Ensure all farm inputs are pest-free
- Develop a documented farm biosecurity plan
- Communicate your farm biosecurity requirements to farm staff and visitors
- Make wash-down facilities available on farm
- Place biosecurity signs at the farm entry points
- Ensure vehicles and machinery come onto farm mud and trash free
- Use farm vehicles to transport visitors around the farm

Things to look for

Pasture mealybugs are very small and may be found in soil, on roots and on leaves as well as on the soil surface. Emergent adults may be seen by the naked eye with careful inspection of the soil, leaves and leaf litter. Early instars nymphs and crawlers and egg masses will require a hand lens (20 or 30 times magnification) and very careful inspection of leaves, roots and soil.

Mealybugs are associated with the symptoms of pasture dieback, and grasses showing symptoms of active dieback such as purple streaks, root rot and patchy death of grasses should be carefully inspected.

Grasses that are dead or roots in very dry and hard soil may no longer contain mealybugs: reproductive masses may persist but may be hard to find. However, mealybugs may be found in apparently healthy grass for several metres around the area of active dieback. Growers and agronomists should inspect plants for dieback symptoms and pasture mealybugs, working outwards from the edge of the dieback.

Grasses should be carefully lifted with a garden fork and placed on a plastic sheet, then inspected closely using a hand lens in good light for insects and reproductive masses on roots and leaves. Care should be taken to distinguish pasture mealybug from Rhodes grass mealybug, which is not a pest problem (see pictures above and links to resources below).

Things that may help

Insecticide application is NOT recommended. There are no registered insecticides for control of pasture mealybug. Application of insecticides risks killing beneficial insects such as the parasitoid that could re-establish control of the mealybug. The cost of insecticide treatment is high, and chemical residues may persist in meat. Mealybugs may persist underground after insecticide application and re-establish in the pasture.

Recent work replanting dieback affected areas with Rhodes grass with a seed coating containing systemic insecticides appeared to offer some protection. However, mealybug was found on pasture grass regenerating adjacent to the Rhodes grass approximately three months after sowing, suggesting protection may be short-lived.

Use of systemic insecticides under an emergency permit may help to manage pasture mealybug where small outbreaks are noticed in a district for the first time and the area can be fenced off from grazing for up to six months. Withholding periods for these insecticides are typically long (six months) and multiple applications may be required. An emergency permit application to APVMA is being developed and field and glasshouse trials on controls are ongoing.

Replanting with non-susceptible forage crops is an option. Legumes do not appear to be hosts for pasture mealybugs and will grow in dieback-affected areas. Lucerne, clover and other forage legumes may provide an option to producers. Forage cereals such as sorghum do not appear to suffer dieback to date. Grazing to reduce matted clumps in which mealybugs thrive may reduce severity.

Application of nitrogen to affected pasture is not recommended as this may promote mealybugs. Other nutrients may provide benefits but impacts on dieback and mealybugs have not yet been demonstrated.

Longer-term management of pasture mealybug is most likely to be achieved through introduction or reestablishment of natural enemies (parasitoids such as the Chalcid wasp, *Callipteroma sexguttata*, or pathogens of the mealybug), and by the use of tolerant grasses and plant endophytes.

Pasture mealybug in New Zealand ryegrass has been effectively managed by identification of endophytes and their commercial use in grass seed (Pennell et al 2005). However, endophytes of tropical grasses are not well studied. Natural enemies, tolerant grass varieties and endophytes are being investigated by Meat and Livestock Australia.

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